

Newspaper or Other Recycled Paper

Crops

Identification of Petitioned Substance

Chemical Names:

None

CAS Numbers:

None

Other Name:Newspaper, newsprint, shredded newspaper,
pelleted newspaper, paper.**Other Codes:**

None

Trade Names:

NA

Characterization of Petitioned Substance

Composition of the Substance:

Newspapers and other recycled papers are usually produced from a mixture of raw plant materials (e.g., wood) and recycled paper. Black and colored inks are applied to the paper, as well as other coatings in some cases. However, glossy paper and colored inks are currently prohibited for use as mulch on the National List of allowed and prohibited substances (USDA 2005). See Evaluation Question #1 for a description of the process used to produce paper. The following subsections describe the composition of paper and ink separately.

Paper

Newsprint consists of 73 percent cellulose and hemicellulose (natural wood fibers), 26 percent lignin (the polymer that binds together cellulose fibers in some plant cell walls), 0.5 percent starch, 0.1 percent polyacrylamide, 0.5 percent polyethylene, and 0.2 percent polyethylene imine (Sundqvist 1999). Table 1 shows the elemental components of paper (Tchobanoglous et al. 1993). The major elements in paper are carbon, hydrogen, and oxygen (Weber-Shirk et al. 1993).

Table 1. Elemental Composition of Two Paper Types on a Dry Weight Basis (Tchobanoglous, et al. 1993)

Constituent	Newsprint	Office Paper
C	49.1%	43.4%
H	6.1%	5.8%
O	43.0%	44.3%
NH ₄ -N	4 ppm	61 ppm
NO ₃ -N	4 ppm	218 ppm
P	44 ppm	295 ppm
PO ₄ -P	20 ppm	164 ppm
K	0.35%	0.29%
SO ₄ -S	159 ppm	324 ppm
Ca	0.01%	0.10%
Mg	0.02%	0.04%
Na	0.74%	1.05%
B	14 ppm	28 ppm
Zn	22 ppm	177 ppm
Mn	49 ppm	15 ppm
Fe	57 ppm	396 ppm
Cu	12 ppm	14 ppm

29 When paper is created through the recycling process, waste paper is used as a source after it is processed
 30 by shredding, de-inking, and brightening. Multiple chemicals are used during paper recycling (see
 31 Evaluation Question #1).

32
 33 **Ink**

34 Printing inks contain pigments, oil carriers, additives, and resins (SunChemical 2004). The specific
 35 components of ink can vary widely. Table 2 shows typical formulations for black inks used in letterpress
 36 and offset printing processes (which account for 53 percent and 47 percent of newspapers printed,
 37 respectively) as provided by the National Association of Printing Ink Manufacturers (NIOSH 1981).
 38

Table 2. Black Ink Formulations

Component	Offset Ink	Letterpress Ink
Carbon Black	16 - 18%	10 - 12%
Hydrocarbon varnish	12 - 15%	-
High boiling aliphatic oil	5 - 10%	-
Flow agent or black ink oil	2 - 5%	2 - 2.5%
Mineral oil	52 - 65%	85.5 - 88%

39
 40 The pigment used for black inks is typically carbon black (an oil derivative) frequently petroleum-based.
 41 However, because petroleum-based inks are sources of volatile organic carbons (VOCs), the use of
 42 vegetable-based oil carriers, or other low-VOC carriers, has been increasing. In 1996, six percent of the
 43 black ink used in newspapers was soy-based (ILSR 1997), with the rest predominantly petroleum-based.
 44 Ink marketed as soy ink probably still contains petroleum products. The American Soybean Association
 45 established informal standards that ink marketed with a SoySeal logo would have to have 40 percent
 46 soybean oil for black ink, and 30 percent soybean oil for colored ink (ILSR 1997). In addition to the
 47 increase in soy-based inks, ink producers have begun developing low-VOC petroleum inks that are
 48 competitively priced with traditional petroleum-inks (US Ink 1997), indicating a shift in the types of black
 49 inks used. US Ink’s Beacon Black contains less than 2 percent VOCs, compared to traditional petroleum-
 50 based inks which contain 5 to 10 percent VOCs (AAFC 2002).
 51

52 Colored inks commonly use vegetable-based oils because they result in better color quality and because
 53 they are priced competitively with petroleum-based colored inks (ILSR 1997). The most common vegetable
 54 oil used is soybean oil (Haynes undated). Historically, pigments used in news ink colors contained
 55 inorganic heavy metals, but recently the use of metals in ink has been restricted, and more inks use organic
 56 pigments (IWRC 1995). Organic pigments are produced through synthetic processes to attain the desired
 57 characteristics of color and crystal size. Some of the typical pigments used in colored newsprint are
 58 Phthalocyanine blue for cyan (copper based), Lithol Rubine for magenta (calcium based), and Diarylide
 59 yellow for yellow (SunChemical 2004, News Limited 2005).
 60

61 **Properties of the Substance:**

62 Paper is a biodegradable substance, but most of the ink applied to paper is not. Newspaper printing inks
 63 are made of pigments carried by a thick fluid, or vehicle. Even when the vehicle is not petroleum-based,
 64 the pigments are. Therefore, soy ink is not 100 percent degradable. Inks with a higher percentage of soy-
 65 based component (in contrast to petroleum-based) are more degradable (Cooke 1995).
 66

67 Pigments in ink may contain trace amounts of heavy metals (IWRC 1995), but studies have shown that
 68 these do not appear to transfer to the soil when newspaper is used as a mulch (see Evaluation Question
 69 #4).
 70

71 In a study conducted by the National Toxicology Program (NTP 1992) 22 polycyclic aromatic hydrocarbons
72 (PAHs)¹ were identified in a petroleum-based letterpress ink while 21 were detected in a petroleum-based
73 offset press ink (NTP 1992).

74
75 Paper recycling introduces other chemicals to the paper-making process. Although in de-inked paper
76 sludge, most toxic compounds are at or below their detection limit (i.e., low or barely detectable levels).
77 De-inked paper sludge can contain chemicals including aluminum, copper, and PAHs (Beauchamp et al.
78 2002). Thus, it is possible that these chemicals would then be transferred to new paper products produced
79 from recycled paper.

80 81 **Specific Uses of the Substance:**

82 The proposed use of the substance is as a mulch to suppress weed growth, moderate soil temperature, and
83 conserve soil moisture (USDA 2005). Paper used as mulch can be shredded or chopped and applied to a
84 depth of four to five inches to soil with crops that are over five inches in height (West Virginia Extension
85 1995). Alternatively, newspaper sheets could be applied between plant rows in a layer six to eight sheets
86 thick, weighed down with soil to prevent them from blowing away (Iowa State 2005). Applied in these
87 ways, newspaper or other paper mulch is expected to:

- 88
- 89 • Control weeds,
- 90 • Keep fruit cleaner and improve color,
- 91 • Add organic matter to soil,
- 92 • Increase yields,
- 93 • Retain soil moisture, and
- 94 • Keep soil temperatures cooler (West Virginia Extension 1995).

95 96 **Approved Legal Uses of the Substance:**

97 No information was found to suggest that newsprint, newspaper, or other paper used as mulch is covered
98 under federal regulations (other than NOP). However, numerous federal standards affect the paper
99 production and printing industries. The pulp and paper industry is regulated by the EPA Cluster Rule for
100 the industry which sets requirements for both air and water pollutant released from facilities (EPA 2003a).
101 Depending on the processes and chemicals used at a printing facility, there are multiple federal regulations
102 that would require compliance including the Clean Air Act requirements (National Ambient Air Quality
103 Standards and the regulation of hazardous air pollutants may apply), Clean Water Act requirements (spills
104 of oil and hazardous substances and discharges into waters, publicly owned treatment works, and storm
105 water sewers), Resource Conservation and Recovery Act (RCRA), Superfund, and Toxic Substances
106 Control Act (EPA 1994). Similar requirements are expected to apply to recycling facilities.

107 108 **Action of the Substance:**

109 Paper mulch works by blocking sunlight from reaching soil, insulating soil, preventing splashing-
110 transmission of disease onto leaves from soil, slowing evaporation and erosion, and adding organic
111 content. (See "Specific Uses of Substance")

113 Status

114 115 **International**

116 Newspaper or other recycled paper is not specifically listed for the petitioned use or other uses in the
117 following international organic standards:

- 118
- 119 • Canadian General Standards Board
- 120 • CODEX Alimentarius Commission

¹ Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 chemicals that are formed during the incomplete burning of coal, oil and gas, or other organic substances. They can be found in crude oil, coal, and tar. They tend to stick to particles, not dissolve in water, and will break down in sunlight. Many PAHs are hazardous to humans and animals (ATSDR 1995).

- European Economic Community (EEC) Council Regulation 2092/91
- Japan Agricultural Standard for Organic Production
- International Federation of Organic Agriculture Movements

Evaluation Questions for Substances to be used in Organic Crop or Livestock Production

Evaluation Question #1: Is the petitioned substance formulated or manufactured by a chemical process? (From 7 U.S.C. § 6502 (21))

Newsprint and other paper are produced from pulp which, in most cases, does involve chemical processes. The stock pulp mixture is produced by digesting source material (either plant material such as wood or secondary fibers from recycled products) into its fibrous constituents via chemical and/or mechanical methods (EPA 2002). Depending on the type of paper being produced, the production process varies. Chemical pulping is the most prevalent process, and is mostly used for producing high-quality paper. Chemical pulping degrades wood by dissolving the lignin bonds holding the cellulose fibers together (e.g., breaking down the “glue” that holds the cellulose together). The most common type of chemical pulping is Kraft pulping which uses a sodium sulfide (Na_2S) and sodium hydroxide (NaOH) solution in a digester (EPA 2002). Mechanical pulping is used principally for production of newsprint and other non-permanent paper goods and relies on physical pressure instead of chemicals to separate fibers, however chemicals are sometimes added at the various states of refining. Secondary fiber is very commonly used for production of paper (EPA 2002). In 2004, 37.1 percent of fiber needs at paper mills were met by using recycled paper (AF&PA 2005). When recycled paper is used as a feedstock, inks are removed by heating the secondary fibers with chemicals such as sodium hydroxide, hydrogen peroxide, sodium silicate, surfactant, and/or fatty acids (ENSR 2000). The secondary fiber is then pulped with water and often pulping chemicals such as sodium hydroxide (NaOH).

After pulp production, the pulp is processed to remove impurities. It may then be bleached using either elemental chlorine free or total chlorine free (sodium hydroxide, chlorine dioxide, hypochlorite, oxygen, ozone, hydrogen peroxide, sulfur dioxide, or sulfuric acid) bleaching technologies. These processes consist of chemical reactions with lignin that increase the whiteness of the pulp. Chlorine free bleaching technologies are used now instead of the traditional elemental chlorine bleach due to environmental and health concerns about dioxins. In the paper-making stage, the pulp may be combined with dyes, strength-building resins, or texture adding filler materials (EPA 2002).

Evaluation Question #2: Is the petitioned substance formulated or manufactured by a process that chemically changes the substance extracted from naturally occurring plant, animal, or mineral sources? (From 7 U.S.C. § 6502 (21).)

For its use as a mulch, newspaper or other recycled paper is not chemically changed, but the original production of paper involves chemical changes. During the pulping process, the bonds between fibers (in the wood or other fiber source) are broken down chemically, mechanically, or by a combination of these two techniques. Chemical pulping degrades wood by dissolving the lignin bonds holding the cellulose fibers together. The chemical process is not used for all paper production (especially not all newsprint production) but at least some chemicals are commonly added even when mechanical pulping is used instead. In addition, the bleaching process that is commonly used causes a chemical reaction with the lignin to increase the whiteness of the pulp (EPA 2002).

Evaluation Question #3: Is the petitioned substance created by naturally occurring biological processes? (From 7 U.S.C. § 6502 (21).)

Newspaper, other paper, and inks are not created by naturally occurring biological processes.

173 **Evaluation Question #4: Is there environmental contamination during the petitioned substance's**
174 **manufacture, use, misuse, or disposal? (From 7 U.S.C. § 6518 (m) (3).)**

175
176 *Manufacture*

177
178 The manufacture of paper involves processes that could result in environmental contamination. The
179 production of new paper of any kind requires logging. Most logging in the U.S. is conducted in a manner
180 to minimize adverse impacts such as runoff, loss of top soil, and loss of irreplaceable ecosystems. Because
181 newsprint is made by a mechanical process and is not bleached, the environmental impacts of manufacture
182 of newsprint are less than the impacts of manufacture of other papers that are made by chemical processes.
183

184 Large amounts of energy are used in production of paper. Fuel sources include: purchased steam, coal,
185 fuel oil, natural gas, other purchased energy, waste wood and wood chips/bark, spent liquor solids (the
186 leftover products from the wood pulping process), other self-generated power. In 1999, spent liquor solids
187 were by far the largest source of power used in making paper (40 percent) (EPA 2002).
188

189 In 2000, the pulp and paper industry was the largest industrial user of water in the U.S. Effluent pollutants
190 from paper making include: solids, biological oxygen demand (BOD), color, reduced sulfur compounds,
191 and sometimes chlorinated organic compounds (associated with bleaching). Common air pollutants from
192 paper making include: fine particulates, nitrogen oxides, coarse particulates, sulfur oxides, ammonia,
193 reduced sulfur gases, and volatile organic chemicals. Water vapors may be visible and in some cases may
194 cause significant obscurement or climate modification (and in those cases would be regulated). Additional
195 pollutants may be produced, depending on specific process used (EPA 2002). Pulp and paper mills
196 produce tons of wood fiber wastes (Beauchamp et al. 2002).
197

198 The printing phase of newspaper production also results in environmental contamination. The top
199 polluting chemicals released from the printing industry are mostly volatile organic compounds (VOCs)
200 including toluene, methyl ethyl ketone, glycol ethers, xylenes, tetrachloroethylene, methyl isobutyl ketone,
201 methanol, 1,1,1-trichloroethane, dichloromethane, and ethylene glycol (ILSR 1997). Releases of these
202 chemicals result from press cleaning operations, blanket washes, and from the ink itself (ILSR 1997).
203 However, due to the reduction in the amount of petroleum and high-VOC ink products being used, these
204 releases are expected to decrease.
205

206 When recycled paper is used in production, the de-inking step results in the use of more chemicals. In de-
207 inking paper sludge (DPS), most toxic compounds are at or below their detection limit (i.e., low or barely
208 detectable levels) (Beauchamp et al. 2002). De-inking paper sludge can contain many chemicals, including
209 aluminum, copper, and polycyclic aromatic hydrocarbons (PAHs) (Beauchamp et al. 2002). The paper
210 recycling process also uses large amounts of water and energy.
211

212 The production of mulch from newspaper could involve no contamination at all if the paper is used locally.
213 If the paper is shredded before use, or transported, there is the potential for environmental contamination
214 associated with the energy used for those processes.
215

216 *Use, Misuse, and Disposal*

217
218 Used as a mulch, newspaper and other recycled paper has the potential to blow away, creating a litter
219 problem; however, sources suggest watering the paper after it is applied and/or weighting it down with
220 soil to prevent this (Iowa State 2005). The paper component of newspaper and other recycled papers is
221 biodegradable, and not expected to cause environmental contamination in its proper use as mulch. Black
222 ink on the paper is not entirely biodegradable, even if the ink is soy-based (Cooke 1995). But in a study
223 comparing shredded newspaper to other mulch options, researchers did not find any heavy metal residue
224 accumulation in the soil which received newspaper mulch (Munn 1992). Volatilizing PAHs are a concern
225 with newspaper inks, but they break down quickly during aerobic decomposition and were not found to
226 accumulate in plants or soil (TAP review 1995).
227

228 Papers with colored inks and glossy papers were not approved for use as mulch under the original TAP
229 review, however, if these are included with the mulch, some sources have warned that color dyes may be
230 harmful to soil microflora and fauna (NRCS 1998), but it is unclear if this pertains to older color dyes that
231 used more heavy metals as compared with newer formulations.

232
233 **Evaluation Question #5: Is the petitioned substance harmful to the environment? (From 7 U.S.C. § 6517**
234 **(c) (1) (A) (i) and 7 U.S.C. § 6517 (c) (2) (A) (i).)**

235
236 Heavy metals and PAHs in newspaper inks are probably not at levels that are harmful to the environment
237 (see Evaluation Question #4). Other concerns with newspaper mulch include the following, summarized
238 by Chalker-Scott (undated):

- 239
- 240 • Pests (termites, rodents) may use the material as food or bedding;
 - 241 • Paper may become dislodged by wind;
 - 242 • Because the mulch may become impermeable to water and gas exchange when compacted, there is
243 the potential for anaerobic conditions on wet, poorly drained soils; and
 - 244 • If allowed to dry out (e.g., during droughty summers or in well-drained soils), the mulch may
245 become hydrophobic, causing rain or irrigation water to sheet away.

246
247 **Evaluation Question #6: Is there potential for the petitioned substance to cause detrimental chemical**
248 **interaction with other substances used in organic crop or livestock production? (From 7 U.S.C. § 6518**
249 **(m) (1).)**

250
251 Based on the intended use of the substance, no information was uncovered to suggest that use of
252 newspaper or other paper as mulch could cause detrimental chemical interaction with other substances
253 used in organic crop production.

254
255 **Evaluation Question #7: Are there adverse biological or chemical interactions in the**
256 **agro-ecosystem by using the petitioned substance? (From 7 U.S.C. § 6518 (m) (5).)**

257
258 The potential for adverse biological or chemical interactions with applications of newspaper as mulch has
259 been addressed in a few research studies. In a study comparing different types of mulch, no accumulations
260 of heavy metals were observed in the soil after using newspaper mulch (Munn 1992), indicating there
261 would not be adverse reactions in crops from metals derived from the newspaper mulch. One reviewer of
262 the original listing for this material indicated that, because of its high carbon to nitrogen ratio, newspaper
263 may cause some immobilization of available nitrogen in soil (Original TAP Database 1995).

264
265 In a summary of studies performed at the Alabama Agricultural Experiment Station, Smith (1997)
266 described one study in which shredded newspaper was applied in and around row crops with no
267 observable adverse environmental impacts. In another study in which processed newspaper products –
268 pellets and crumbles – were applied to container-grown nursery plants, the researchers found a slight
269 reaction in annual plants to aluminum in the mulches, which they attributed to the manufacturing process
270 of paper (Smith 1997).

271
272 **Evaluation Question #8: Are there detrimental physiological effects on soil organisms, crops, or**
273 **livestock by using the petitioned substance? (From 7 U.S.C. § 6518 (m) (5).)**

274
275 No detrimental physiological effects are expected if newspaper or other recycled paper, excluding papers
276 with colored inks and glossy pages, are used as mulch.

277
278 **Evaluation Question #9: Is there a toxic or other adverse action of the petitioned substance or its**
279 **breakdown products? (From 7 U.S.C. § 6518 (m) (2).)**

280
281 No toxic or adverse actions have been documented in studies using newspaper mulch.

282

283 **Evaluation Question #10: Is there undesirable persistence or concentration of the petitioned substance**
284 **or its breakdown products in the environment? (From 7 U.S.C. § 6518 (m) (2).)**
285

286 Paper should decompose rapidly, and not persist over time (MSU 2005). Breakdown products of the inks
287 used on newspapers or other recycled papers are the only potential concern. PAHs are chemicals of
288 concern associated with newspaper ink, but one reviewer of the original listing indicated that the PAHs
289 potentially associated with inks would break down quickly in the environment and would not accumulate
290 (Original TAP Database 1995). This reviewer cited a 1995 publication from the Woods End Research
291 Laboratory.

292
293 Heavy metals may be added to soil as a result of newspaper application, but two studies indicated that the
294 concentrations associated with newspaper mulch application are not a concern. Munn (1992) measured no
295 heavy metal accumulation in soil from newspaper mulch application. In a study designed to compare the
296 use of recycled newspaper to straw and wood shavings for use as animal bedding, Ward et al. (2000)
297 analyzed municipally collected newspapers for heavy metal content. The content of cadmium, chromium,
298 mercury, and lead in the newspaper bedding were all much less than the EPA guidelines for sewage
299 sludge application, and were very similar to the levels observed in the straw and wood shavings (Ward et
300 al. 2000). In addition, paper with colored or glossy paper was not filtered out of the sample used in the
301 study, so it is expected that heavy metal content of the type of paper on the National List would have even
302 less heavy metal residue.

303
304 In the same study of using newspaper as animal bedding, Ward et al. (2000) analyzed the paper for dioxins
305 and furans, and only detected 2,3,7,8 tetrachlorodibenzofuran (2,3,7,8-TCDF) in the newspaper product.
306 The level of 2,3,7,8-TCDF resulted in a toxic equivalent (TEQ) of 0.37 ng/kg. Although the U.S. EPA does
307 not regulate dioxins in land-applied sewage sludge (EPA 2003b), this value is below the level agreed upon
308 between paper companies and U.S. EPA regarding land application of paper mill sludge, which is 10
309 ng/kg TEQ for unregulated spreading (Harrison et al. 1999).

310
311 **Evaluation Question #11: Is there any harmful effect on human health by using the petitioned**
312 **substance? (From 7 U.S.C. § 6517 (c) (1) (A) (i), 7 U.S.C. § 6517 (c) (2) (A) (i) and 7 U.S.C. § 6518 (m) (4).)**
313

314 There is evidence of potential skin irritation and increased cancer incidence related to direct exposure to
315 petroleum-based inks and printing. However, no studies were identified assessing risks due to using
316 newspaper as mulch, and studies performed directly with ink or occupational studies in the printing
317 industry most likely overestimate exposures that would occur using the paper as mulch. A concern raised
318 by a reviewer of the original listing for this substance was that if the newspaper/paper were shredded,
319 cellulose dust could present a risk to human health, should probably be considered more carefully than
320 risks due to dermal exposure to inks (Original TAP Database, 1995).

321
322 A study was conducted by the National Toxicology Program (NTP) assessing the toxicity of black
323 petroleum-based newsprint inks administered topically to rats and mice (NTP 1992). Results of the study
324 indicated that dermal administration of black newsprint inks and mineral oils produce local toxicity at the
325 site of application in mice, consistent with a primary cutaneous irritant. In rats, the evidence for toxicity
326 was limited to decreased body weight gains in females. In addition, epidemiological studies cited in the
327 NTP (1992) report have shown a clear association between occupational exposure to PAHs and/or
328 petroleum products (including mineral oil and carbon black), and an increased incidence in cancer
329 (Bingham et al. 1980, IARC 1984). Other studies have shown high prevalence of dermatitis (skin irritation)
330 among workers in the printing industry, although non-chemical causes such as frequent hand washing
331 were identified as potential causes not related to chemicals (Livesley et al. 2002). Petroleum-based black
332 inks and their ingredients may have the potential to be harmful to humans, however, in the proposed use
333 of the product, it is not expected that humans would be exposed to inks at levels corresponding to either
334 the animal or occupational studies.
335

336 **Evaluation Question #12: Is there a wholly natural product which could be substituted for the**
337 **petitioned substance? (From 7 U.S.C. § 6517 (c) (1) (A) (ii).)**
338

339 Multiple products can be used as mulch, depending upon resources that are available and the crops being
340 grown. The National Organic Program's definition of mulch includes wood chips, leaves, and straw as
341 natural materials that can be used (USDA 2005). Other natural alternatives that have been used are bark
342 mulch, grass clippings, and compost (NRCS 1998). In one study, Munn (1992) compared the use of
343 newspaper mulch to wheat straw on sweet corn, soybean, and processing tomatoes and found that, in
344 terms of impact on yield, weed control, soil moisture, and soil temperature, newspaper mulch and wheat
345 straw mulch performed similarly.

346
347 **Evaluation Question #13: Are there other already allowed substances that could be substituted for the**
348 **petitioned substance? (From 7 U.S.C. § 6518 (m) (6).)**
349

350 Other allowed products on the National List include plastic mulch and covers (petroleum-based other than
351 polyvinyl chloride (PVC)) (USDA 2005).

352
353 **Evaluation Question #14: Are there alternative practices that would make the use of the petitioned**
354 **substance unnecessary? (From 7 U.S.C. § 6518 (m) (6).)**
355

356 Mulch provides a variety of benefits for crop production. However, there are alternative practices that
357 could be used instead to provide some of the benefits that mulch provide. For weed problems, options
358 include mowing, livestock grazing, hand weeding and mechanical cultivation, flame, heat, or electrical
359 means (USDA 2005). Proper crop rotation can serve to maintain soil organic matter, provide pest
360 management, and provide erosion control (USDA 2005). In addition, other materials besides newspaper
361 could be used as mulch (see Evaluation Questions #12 and #13). However, the added benefit of using
362 newspaper or other recycled papers as mulch is reducing the solid waste stream.

363
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